

**Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter by ASTM D4809-09a**

Facility Name: \_\_\_\_\_ VELAP ID: \_\_\_\_\_

Assessor Name: \_\_\_\_\_ Analyst Name: \_\_\_\_\_ Inspection Date: \_\_\_\_\_

**Relevant Aspect of Standards****Method  
Reference****Y****N****N/A****Comments***Records Examined:* SOP Number/ Revision/ Date \_\_\_\_\_ Analyst: \_\_\_\_\_

Sample ID: \_\_\_\_\_ Date of Sample Preparation: \_\_\_\_\_ Date of Analysis: \_\_\_\_\_

Is either a isoperibol or adiabatic calorimeter used?

4.1

Are the balances sensitive to 0.01 mg and 0.05 g?

6.2-3

Are reagent grade chemicals used unless they are first determined to be of sufficiently high enough purity as to not lessen the accuracy of the test?

7.1

Was Type IV or better water used?

7.2

Was the benzoic acid pelletized before use?

7.3

Was 0.0866 N NaOH solution and 0.0725 N Sodium Carbonate solution used?

7.8.1-2

Was the liquid-in-glass thermometer, accompanying thermistor, and water jacket thermistor all installed at the same depth and so that the bulb is halfway to the bottom of the bucket without touching the bomb, bucket or water jacket?

8.1

Was the initial energy equivalent made by averaging a minimum of six benzoic acid determinations over a period of at least 3 days with an RSD of 0.1% or less?

9.1

Was the energy equivalent value thereafter determined every 1 to 2 days of testing using the average of the last 6 determinations with an RSD of 0.1% or less?

9.1.1

Was the heat of combustion of the pressure sensitive tape initially determined per Section 10 averaging at least 3 determinations and redetermined for each new roll?

9.2

Notes/ Comments:

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Were the bomb and all fittings dry inside and out before sample analysis?	10.2				
Were forceps used to weigh the sample cup to 0.01 mg and which was then covered with pressure sensitive tape (for low boiling samples below 180°C) before sample injection and reweigh?	10.5.1				
Was the sample cup placed in the curved electrode with a 100mm firing wire arranged so that the central loop presses down on the center of the tape disk?	10.5.2 and 10.3				
Was the bomb attached to the oxygen cylinder and pressurized to 3.0 MPa after which it was disconnected and the valve cover replaced? (Note 7: pressures 2.5-3.55 MPa may be used if consistent for all tests and standardization)	10.6				
For Isoperibol Method: Was the assembly of the calorimeter bomb and bucket a few tenths of a degree below the desired initial temperature?	10.7.1.1				
For Adiabatic Method: Was the initial temperature for all determinations at a fixed value with a mean of $\pm 0.5^{\circ}\text{C}$ and a rise for all determinations within $\pm 0.3^{\circ}\text{C}$ ?	10.7.1.2				
Was the calorimeter bucket weighed to the nearest 0.05 g and filled with the same amount water (2000 to 2100 g) to cover the bomb and its fittings for each determination?	10.7.2				
Immediately after weighing, was the bucket placed in the calorimeter jacket and the bomb placed in the jacket with the cover closed and thermometers lowered?	10.7.3				
<b>PROCEDURE FOR ISOPERIBOL METHOD:</b>					
Was the stirrer motor and controller started to bring the water in the jacket to 28°C and then time and temperature readings recorded over a 25 minute period?	10.8.1				
Were the initial period temperatures recorded at one minute intervals?	10.8.2				

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When the firing temperature was reached, was the sample fired by closing the firing circuit through the fuse wire in the bomb by depressing the button on the ignition unit?	10.8.3				
After the combustion of the sample and during the middle period when the temperature rises rapidly, was the temperature recorded at 30 s intervals and continued until the rate of the temperature change was constant for at least 10 min?	10.8.3				
<b>PROCEDURE FOR ADIABATIC METHOD:</b>					
Was the jacket temperature manually set to be in close agreement with the bucket temperature and allowed to equilibrate for 15 minutes?	10.9.1				
At the beginning and end points, was the jacket temperature controlled to within 0.005°C of the bucket temperature?	10.9.1				
Were readings made at 1 min intervals until 3 readings showed no change at which point the sample was fired?	10.9.1				
Was the initial resistance read and recorded estimated to the nearest 0.00005°C?	10.9.1				
After 6 min from firing, was the temperature read every minute until 3 consecutive readings show no change or decrease?	10.9.2				
Was the final temperature recorded as an estimate to the nearest 0.0005°C?	10.9.2				
<b>ANALYSIS OF THE BOMB CONTENTS:</b>					
Was the needle valve opened and the gas allowed to escape at a uniform rate in not less than 1 min?	10.10.1				
If any trace(s) of unburned carbon were found, was the experiment rejected?	10.10.1				
Were the bomb and electrodes washed with a minimal amount of water quantitatively into a 500-cm <sup>3</sup> and titrated with a standard alkali solution using methyl red?	10.1.1				
Notes/ Comments:					

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Was the sulfur content determined to the nearest 0.02% using one of the following test methods: D129, D1266-IP 107, D2622, D3120, D4294, or D5453?	10.10.2				
When iron or Chromel C wire was used, was it removed, measured and recorded as to wire consumed?	10.10.3				
Was the temperature rise calculated and graphed according to Section 11.1 or 11.2?	11.1-11.2				
Were the thermal corrections calculated according to Section 11.3 for each test?	11.3				
Was the gross heat of combustion calculated using the equation in Section 11.4 and reported to the nearest 0.002 MJ/kg?	11.4				
Was the net heat of combustion calculated using the equation in Section 11.5 and reported to the nearest 0.002 MJ/kg?	11.5				
<b>ANNEXES (Mandatory Information)</b>					
Was the room where the calorimeter was operated free from drafts, not subject to sudden temperature changes and held constant throughout the year in the range of 23 to 26°C?	A1.1				
Was the bomb designed so that all liquid combustion products could be completely recovered by washing the inner surfaces with no gas leakage during the test (withstanding a hydrostatic pressure of 20.7 MPa at room temp)?	A.1.2				
Did the calorimeter bucket have the ability to stir for 10 min without raising the temperature more than 0.01°C and of a size that it was completely immersed in water when assembled?	A.1.3				
Were the calorimeter bomb, bucket and water completely enclosed within a stirred water jacket and supported so that its sides, top and bottom are ~1cm from the jacket walls?	A.1.4				
Were the correct thermometers used and calibrated per A.1.5 for the jacket and calorimeter?	A.1.5				
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Was a 6 to 16 V alternating or direct current used for ignition (or a step-down transformer connected to a 115V 50/60-Hz lighting circuit) used?	A1.7				
Was a timing device capable of measuring time to 1 second used for the Isoperibol method?	A.1.8				
Was a low form platinum cup, 26mm in diameter and 11mm deep with a spun rim used? Note: Base metal alloy crucibles are acceptable if after a few preliminary firings the weight did not change significantly between tests.	A.1.9				

Notes/ Comments: